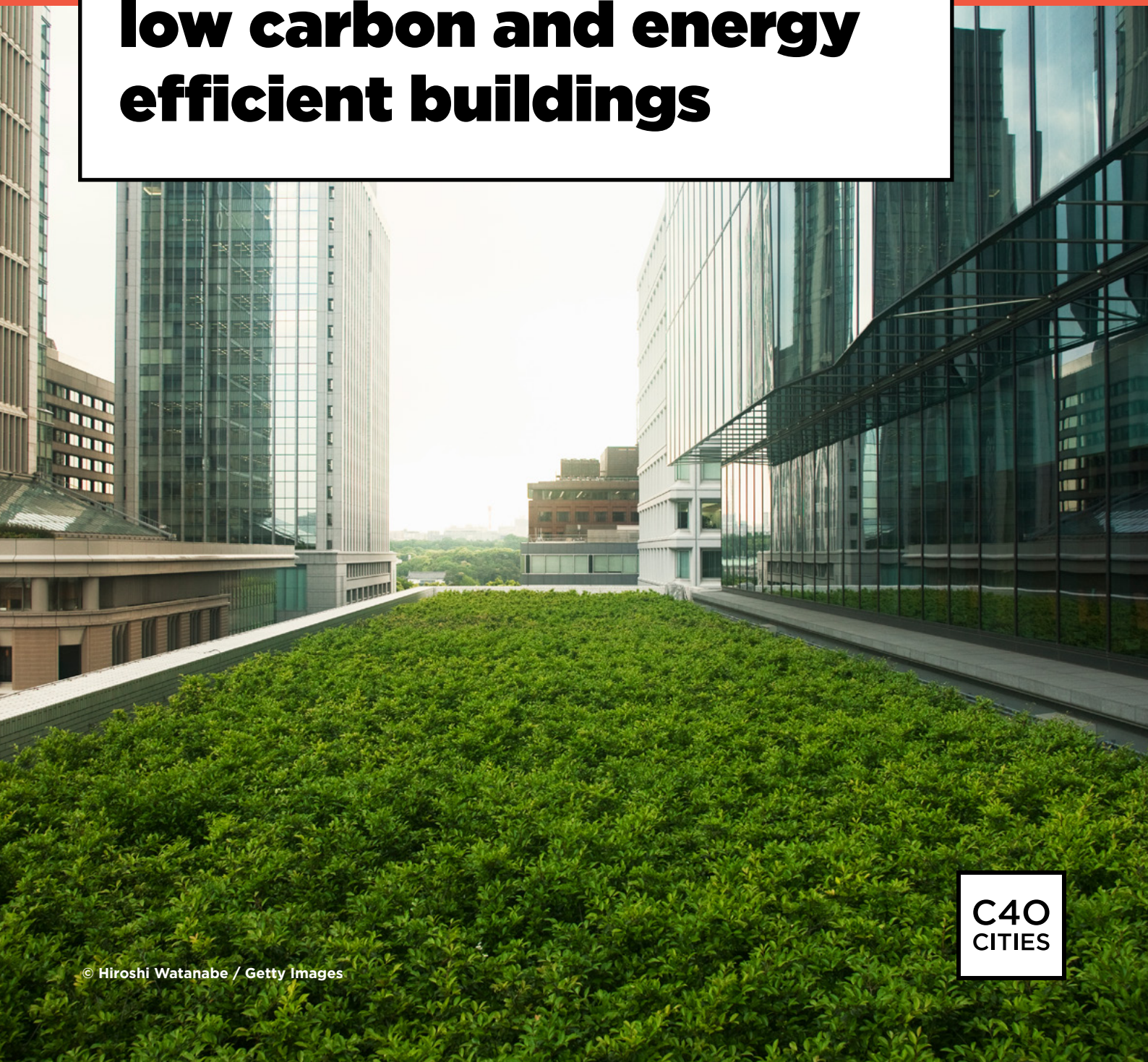
C40 NET ZERO CARBON BUILDINGS DECLARATION:

How cities are delivering low carbon and energy efficient buildings



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C40 CITIES

ACKNOWLEDGEMENTS

This report was created in collaboration with each of the signatory cities of the C40 Net Zero Carbon Buildings Declaration. Each city section including the summary and the city resident impact stories were self-reported. The city summaries showcase past, present, and future actions the city is implementing to achieve the goals of the declaration. For further information on the C40 Net Zero Carbon Buildings Declaration, please check out the declaration webpage here.

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FOREWORD

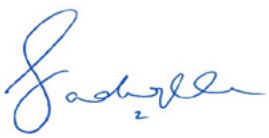
Many cities are among those on the frontline of climate change, feeling the impacts of record-breaking temperatures, rising sea levels, and climate related natural disasters.

Since 2017, C40's Declarations and statements of political leadership – based on the toughest science-based targets and allied to concrete delivery milestones – have been signed by bold and forward-thinking Mayors. These reports document the ambitious action that has been implemented within cities. The importance of acting now is greater than ever. Focusing on achieving carbon neutrality by 2050 gives people a false sense of the time we have left to solve the climate crisis, and these Mayors have acknowledged that when it comes to creating safe, inclusive, resilient cities we must act now.

Despite the many challenges faced in recent times, with the global pandemic, economic disruption and upheaval, climate related natural disasters and in many cases strained financial resources, C40 cities have continued to act and have more than doubled the number of high-impact climate actions implemented in the six years since the Paris Agreement was signed. Cities have also already delivered more than 270 actions and are on track to deliver more than 900 additional actions by 2030, creating urban environments that allow citizens to thrive through creating streets that put people first, cleaning the air that people breathe, creating low-cost and energy efficient homes and offices, ensuring citizens have access to balanced and nutritious food that does not harm the planet and advancing towards zero waste policies.

This must be a decade of action, with cities accelerating their efforts to tackle greenhouse gas emissions. For that reason, I have brought my own commitment to making London net zero forward by 20 years to 2030. I have also recently set out my preferred pathway to 2030 and identified further bold actions that London will need to take to achieve this goal. Delivery will require action by many stakeholders, but by setting out a bold and ambitious approach of our own we can encourage others to follow our example.

Congratulations to the cities featured in these reports for their leadership in creating **The Future We Want**, by demonstrating that their commitments are not empty words, but bold actions, and for driving the change needed for a safe planet for future generations.



Sadiq Khan
Mayor of London and Chair of C40 Cities

INTRODUCTION

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Buildings are one of the largest sources of greenhouse gas (GHG) emissions, accounting for over half of total city emissions on average, and are a significant source of air pollution. Urgent action is required to halve emissions by the end of the decade to stay on track for 1.5 degrees Celsius helping to avoid climate breakdown. Net zero carbon buildings play a crucial role in this transition.

By 2060, the world is projected to add 230 billion m^2 of buildings, or an area equal to the entire current global building stock[1]. Meanwhile, analysis of European structures has shown us that 75% of today's buildings are likely to still be standing in 2050[2]. Despite the significant challenges this presents, this is an opportunity to improve the places we live, work, and occupy on a pathway to net zero carbon.

Compared to business-as-usual, energy efficient buildings improve health, are more comfortable, create jobs, reduce fuel poverty, increase climate resilience, reduce pressures on energy infrastructure, and reduce greenhouse gas emissions[3]. Through the right policies, we can transform the built environment so that it mitigates emissions, is adapted to a changing climate, and delivers thriving, liveable cities with benefits shared equitably across all communities. The significant gap in building decarbonisation policies at the national level further highlights the important role cities play. The C40 Net Zero Carbon Buildings Declaration brings cities together to demonstrate collective climate leadership, and this declaration report showcases the ambitious actions cities are undertaking to deliver the net zero carbon buildings of the future.

[1] UN Environment, Global Status Report 2017
[2] EC, Comprehensive study of building renovation activities and the uptake of nearly zero-energy buildings in the EU, 2019
[3] C40, The Multiple Benefits of Deep Retrofits, 2020

There are 28 cities[4], including 23 C40 cities, that have signed the C40 Net Zero Carbon Buildings Declaration pledging to enact regulations and/or planning policy to ensure **new buildings operate at net zero carbon by 2030 and all buildings by 2050**. To meet these commitments, cities will:

- Establish a roadmap demonstrating commitment to reach net zero carbon buildings
- Develop a suite of supporting incentives and programs
- Report annually on the progress of regulations and policy towards targets, and evaluate the feasibility of reporting on emissions beyond operational carbon (such as refrigerants)

There is also an optional third commitment, which 16 cities have signed, that relates to municipal buildings. Cities can commit to **owning, occupying and developing only assets that are net zero carbon in operation by 2030.** To meet this commitment cities will:

- Evaluate the current energy demand and carbon emissions from municipal buildings, and identify opportunities to improve
- Establish a roadmap demonstrating commitment to reach net zero carbon buildings
- Report annually on building performance towards targets, and evaluate the feasibility of including emissions beyond operational carbon (such as refrigerants).

Through adopting these commitments our signatories are placing themselves at the cutting edge of climate action in cities, however a broad range of other stakeholders are simultaneously stepping forward to take collective action. Worldwide, 122 businesses and six states and regions have pledged to deliver net zero carbon buildings through the World Green Building Council's Net Zero Carbon Buildings Commitment[5], reflecting the importance of coalition building in our response to the climate crisis.

[4]Non-C40 signatory cities include Newburyport, San Jose, Santa Monica, Helsinki and Valladolid
[5]WGBC, The Net Zero Carbon Buildings Commitment

Commitment 1 New buildings	Commitment 2 Existing buildings	Optional Commitment 3 Municipal buildings
Enact regulations and/or planning policy to ensure new buildings operate at net zero carbon by 2030	**Enact regulations and/or planning policy to ensure all buildings operate at net zero carbon by 2050**	**Own, occupy, and only develop assets that are net zero carbon in operation by 2030**

C40 CITY SIGNATORIES

Cape Town*
Copenhagen*
Durban*
Heidelberg*
Johannesburg*
London
Los Angeles
Medellin*
Melbourne*
Montreal*
New York City
Oslo*
Paris*
Portland*
San Francisco
Seattle
Stockholm*
Sydney*
Tokyo
Toronto*
Tshwane*
Vancouver*
Washington DC

***Cities choosing to adopt commitment 3 targeting net zero carbon municipal buildings by 2030**

EXECUTIVE SUMMARY

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As we move into a critical phase of global climate action, cities are leading the way by committing to the most ambitious targets possible through the C40 declarations. In signing the C40 Net Zero Carbon Buildings Declaration, cities pledge to implement a roadmap to decarbonise the built environment in line with the 1.5 degrees Celsius target of the Paris Climate Agreement.

To share the important actions cities are accomplishing, a collective progress report, 'How Cities are Building the Future We Want: City progress towards meeting Net Zero Carbon Buildings Declaration commitment' was first published in 2019. Since its publication, the global landscape has changed drastically due to the COVID-19 pandemic and the continued challenges of the climate crisis. However, cities have continued to take strides towards a healthier, more equitable, and carbon neutral built environment.

In this report, we will explore some of the actions cities are taking to move along the net zero carbon buildings pathway. Cities have taken ambitious steps in developing long-term, evidence-based, net zero carbon building roadmaps providing necessary details on how net zero will be reached, and the timeframes and milestones that will be met. Signatory cities are also implementing key actions to increase energy efficiency and drive emissions reductions, such as increasing energy efficiency requirements in building codes for new buildings and introducing building performance standards for existing buildings. These policies require high performance building envelopes, and modern heating and cooling technologies like heat pumps. There is also a clear increase across cities in energy monitoring, building audits and dynamic building energy modelling which provides vital data for cities to drive more ambitious policies and set targets. Efforts to electrify buildings are progressing, through gas bans for new buildings and switching fossil fuel heating systems with electric ones. Cities are also reducing their reliance on fossil fuels through increased deployment of building scale renewable energy, as well as off-site renewable energy procurement.

Across all signatory cities, many buildings are already being built to net zero carbon or passive house standards. The workforce expertise gained from these groundbreaking developments is then being shared to the benefit of a wide range of industry stakeholders. Other impacts of city policies such as job creation and energy bill savings are being assessed to ensure the benefits can be distributed equitably and to ensure that negative outcomes are avoided.

Cities are currently faced with an unprecedented set of challenges; the COVID-19 pandemic has further limited the available resources cities need to deliver detailed and ambitious policies, while also forcing cities to reassess how buildings and public spaces are used now that behaviours have changed in response to the pandemic. Additionally, many cities find themselves at odds with uncooperative government partners at the national and state levels. Despite these challenges, cities continue to drive innovative solutions, yet it is clear that we need to continue accelerating our efforts to decarbonise the built environment as we are not yet on a trajectory that will keep us safe from the worst impacts of the climate crisis.

Net Zero Carbon Buildings and Equity

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Climate action in cities can help enhance social equity, providing multiple benefits for city residents. In delivering their Net Zero Carbon Buildings Declaration commitments, cities have conducted equity assessments to evaluate the positive and/or negative impacts of their climate actions on city residents, and to inform the equitable delivery of these actions. Some highlights from cities who voluntarily reported their equity assessments are:

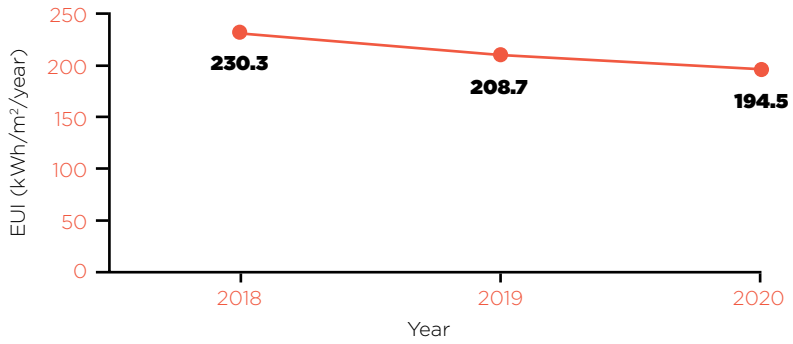
- Assessments on shifting all new buildings to net zero and how this could create work opportunities in skilled trades, but also address risk of displacement brought about by building performance standards driving up rents (Los Angeles, Seattle & Toronto)

- Helping to reduce the energy burden for people of colour and low-income households, address health inequalities and the 'food or fuel' concerns among low-income households and those most vulnerable to the cold such as the elderly and youth (London & Seattle)

DATA ANALYSIS

During this reporting cycle, cities reported qualitatively on their progress towards implementing a net zero carbon buildings roadmap for each of the declaration commitments. Where data was available, quantitative progress was tracked to measure trends in energy efficiency and carbon emissions of buildings. Not all declaration cities had access to data of this kind. However, for cities with data access we demonstrate below how building energy efficiency (energy use intensity) and building emissions (greenhouse gas emissions intensity) are changing over time.

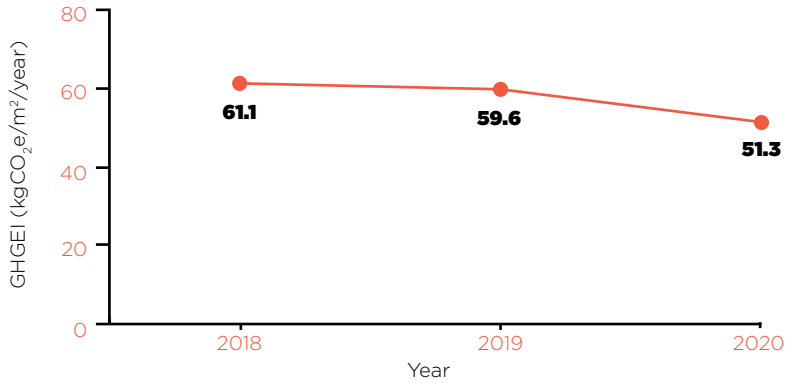
Multi-city Average of Energy Use Intensity (EUI) of Private Buildings, kWh/m²/year



For cities that reported trend data we have been able to show, in overview, how average energy use intensity of private buildings has been decreasing over time[6].

● Average Energy Use Intensity

Multi-city Average of Greenhouse Gas Emission Intensity (GHGEI) of Private Buildings, kgCO_2e/m²/year



For cities that reported trend data we have been able to show, in overview, how average greenhouse gas emission intensity of private buildings has been decreasing over time.

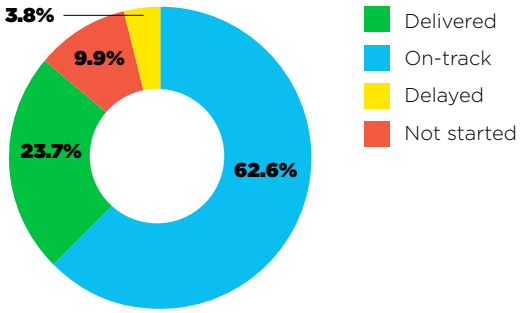
● Average Greenhouse Gas Emission Intensity

Eight cities across Europe and North America, that have been active in reducing the energy demands and greenhouse gas emissions of private buildings, provided data for this analysis. These actions include efforts to decarbonise heat networks, gather energy use data to underpin science-based policies and roadmaps, and provide tools and mechanisms to finance energy efficient retrofit.

[6]Because of inconsistencies in energy measurement and carbon accounting methodologies across regions, it is not possible to compare cities directly. Instead we are focusing on the trends over time. For this reason we have not included cities with a single yearly dataset, but will be adding more cities in subsequent reporting cycles. In order to represent large and small cities equally we have not area weighted the average, we have taken the yearly mean across cities reporting trend data in city-wide EUI and GHGEI.

C40 cities reported their progress against a set of six predetermined roadmap actions per commitment. This provided a consistent framework for the reporting, allowing cities to demonstrate if they were on track to complete these steps that eventually led to net zero carbon performance in buildings. Across all signatories, a high proportion of actions are on track or delivered, as shown in the graphs below with a breakdown per commitment.

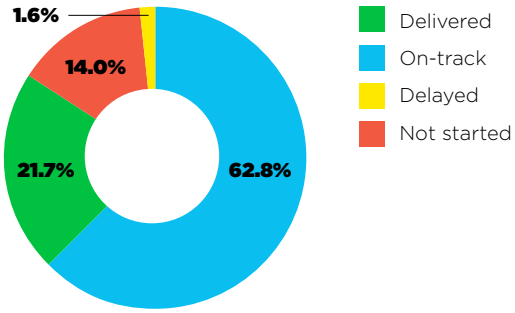
Commitment 1:
Net Zero Carbon New Buildings
Roadmapping to net zero carbon by 2030: Status of roadmap actions



Each city reported progress against a framework of six best practice roadmap actions, leading to NZC performance in all new buildings by 2030.

This includes new policies and regulations in Durban, Johannesburg, San Francisco, and Seattle.

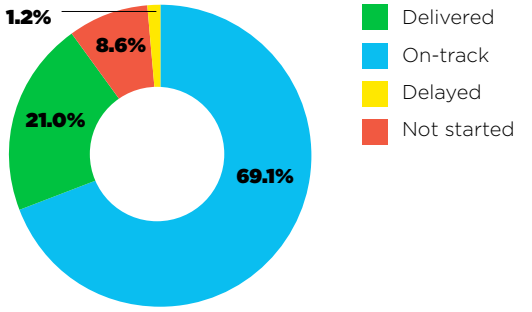
Commitment 2:
Net Zero Carbon Existing Buildings
Roadmapping to net zero carbon by 2050: Status of roadmap actions



Each city reported progress against a framework of six best practice roadmap actions, leading to NZC performance in all existing buildings by 2050.

This includes Montréal gathering data to understand how energy is used across their buildings, and New York and Washington DC implementing mandatory performance targets to tackle emissions, following Tokyo who led on these efforts through their Cap-and-Trade Program

Commitment 3:
Net Zero Carbon Municipal Buildings
Roadmapping to net zero carbon by 2030: Status of roadmap actions



Each city reported progress against a framework of six best practice roadmap actions, leading to NZC performance in all municipal buildings by 2030.

This includes cities such as Copenhagen and Cape Town taking action on their municipal buildings by conducting energy audits and installing energy monitoring systems.

1,044,866 m²

Total floor area of new Passive House & Net Zero Carbon buildings permitted or completed since 2019. This includes Heidelberg, where a district masterplan mandates passive house standards.

99,185 MWh

Total megawatt hours of renewable electricity generated on buildings since 2018

CITY PROGRESS SUMMARIES

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The following section of this report contains progress and action summaries that were self-reported by each of the C40 Net Zero Carbon Buildings Declaration signatory cities. The city summaries showcase past, present, and future actions the city is undertaking to achieve the implementation milestones of the Declaration.

CAPE TOWN

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Cape Town is a signatory to all three commitments within the C40 Net Zero Carbon Buildings Declaration, including leading by example in its own operations for new and existing facilities as well as developing and implementing policies and regulations for all other new and existing buildings. These commitments are in line with national policy directives, particularly those articulated in the draft National Energy Efficiency and Climate Change Strategies and the National Development Plan, which envisages net zero emission building standards by 2030.

The city's measures include promoting the adoption of more stringent energy efficiency targets and renewable energy use in new buildings. Beyond having more stringent energy efficiency targets, the city is taking a multi-pronged approach to achieving net zero carbon — ranging from increasing institutional capacity, developing awareness campaigns and financing mechanisms, implementing city-owned renewable energy projects, and enabling the purchase of renewable energy from independent power providers.

Energy use in buildings in Cape Town accounts for the largest contribution to greenhouse gas emissions, and this is reflected in three of the goals of the city's recently launched Climate Change Action Plan (2021):

- All new residential and commercial buildings will be net zero carbon by 2030 (goal 15).
- All new and existing municipal buildings will be net zero carbon in operation by 2030 (goal 17).
- All existing residential and commercial buildings should operate at net-zero carbon by 2050 (goal 16).

To achieve these goals, the city aims to:

- Explore and implement mechanisms that facilitate the uptake of energy efficiency and renewable energy measures in all buildings.
- Ensure that state-subsidised housing is energy efficient and climate resilient.
- Optimise energy demand through energy efficiency retrofits, energy audits, and energy and water metering programmes in municipal facilities to achieve net zero carbon in operation by 2030
- Increase awareness on designing, constructing, and operating net zero carbon buildings.

CAPE TOWN

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My Clean Green Home

My Clean Green Home is the result of a design competition run by the city of Cape Town and the Green Building Council of South Africa, as part of the Cape Town Future Energy Festival. The competition was targeted at students and professionals in the built environment to design a net zero carbon home for display and exhibition purposes. It was aimed at teaching the public about design principles, technologies and behaviours needed to meet the net zero carbon targets and to demonstrate that net zero carbon houses are feasible, accessible and can be achieved by everyone. The competition received 13 innovative design entries. The winning design was a modular 'house in a box' covered by an overarching tree-like structure made from 85 upcycled shipping pallets and two shipping containers. The design incorporates rainwater harvesting, solar power generation, passive cooling and an edible food garden. The My Clean Green Home is now permanently housed as part of the Experiential Garden at the Green Point Urban Park to ensure it can be used as an ongoing tool for the public to generate awareness around sustainable living and the city's goals on carbon neutrality.

Through this My Clean Green Home campaign, many city residents made pledges in person at the exhibit or on the festival's Facebook page to implement changes in their homes and to take action for a stronger Cape Town.

COPENHAGEN

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Copenhagen's ambitious Climate Action Plan will ensure that the city is supplied by 100% carbon neutral electricity and heat in 2025, making all buildings net zero carbon.
The national building energy codes set high requirements for new buildings, and therefore the city of Copenhagen is focusing on existing buildings and decarbonising the electricity and heat supply with the publicly owned utilities. Together with the city utilities, Copenhagen will invest in new wind turbines, heat pumps, biomass-fuelled combined heat and power plants, and other solutions.

Copenhagen has succeeded in reducing total electricity consumption by over 10% for households and over 20% for retail and service businesses in 2020 compared to 2010; heat consumption is however above the 2010-level, partly because the number of buildings has increased. Generally speaking the building stock in the city is fairly energy efficient.
Due to fuel switching in the city's energy systems, CO_2 emissions have been reduced by 74% for electricity and 64% for heat over the same period.

One of the most ambitious initiatives Copenhagen is investing in is Energy Leap, a network for the largest building owners in Copenhagen, targeting a 3% annual energy reduction in all buildings. The network includes 46 partners, which currently account for approximately 26% of the total building stock in Copenhagen.

In municipal buildings, the city has a 40% energy reduction goal by 2025 (compared to 2010). In 2020 the city was about half way towards reaching this goal. Actions included the installation of building management systems, the undertaking of a large number of refurbishments, and the installation of a comprehensive energy surveillance system in all municipal buildings. Using this hourly energy data, the city can now develop a business case for further refurbishment, as well as tracking performance of completed projects. The city trains staff in the energy efficient operation of its buildings and leads the C40 Municipal Building Efficiency network.

DURBAN

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The eThekwini Municipality (Durban) Council adopted the eThekwini New Buildings Green Policy in April 2021. This policy puts in place some regulations, which will see all new buildings being built according to net zero carbon requirements from 2030. A council resolution tabled in 2019 developed the authority to draft the New Buildings Green Policy. This was made possible through collaboration between multiple departments, with a strong commitment to taking climate action. Further support for developing the policy was offered through the C40 South Africa Buildings Programme. The programme saw the municipality receive technical and legal support. The programme concluded at the end of June 2021, however the municipality is continuing to advance a number of related initiatives.

The policy will serve a number of purposes:

- Achieve net zero carbon in all new buildings and maintain high efficiency levels,
- Reduce operating costs throughout the lifecycle of new buildings,
- Increase resilience in buildings and infrastructure through adapation actions,
- Secure into the future the asset value of new developments,
- Increase the demand for energy efficient technologies and professionals within the building sector.

Key planned activities include operationalisation of the recently adopted eThekwini New Buildings Green Policy and finalisation of the eThekwini Green Building Incentive Policy — a financial incentive for new green rated buildings.

HEIDELBERG

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Heidelberg requires net zero carbon building development through the Energy Concept 2010 programme. All new municipal buildings and developments on land owned by the city must meet 'passive house' standards. This policy is currently under review, and the aim is to raise requirements to 'passive house plus'. This policy has led to the establishment of the Bahnstadt district, known for being one of the largest passive house districts in the world. The district, which began in 2009, has monitored energy use in occupation, showing us that residential buildings achieve an average total heat consumption of 51.7 kWh/(m^2a) and average electricity consumption of 30.1 kWh/(m^2a). A more detailed analysis of two buildings shows that further optimisation is possible. The success of the Bahnstadt's energy concept has led to similar concepts for several other districts including the Heidelberg Innovation Park as well as the former US army base, the Patrick Henry Village.

A key factor in the progress towards net zero carbon buildings will be to convince building owners to retrofit their buildings to a high standard. One plan is to involve the local climate protection and energy consulting agency as well as the NGO BUND, affiliated with the international Friends of the Earth network, in a retrofit campaign. The campaign should offer a low-threshold consultancy service for house owners as well as information events and construction site visits. The City of Heidelberg is planning to continue and adapt its municipal support programme for energy retrofits to attract a wider base and encourage more building owners to invest in highly efficient retrofits. One of the first steps will be to make the municipal programme compatible with the federal retrofit funding programme, offering additional bonuses and generally making the application and audit process easier and quicker for everyone. District energy systems also offer cities a great opportunity to decarbonise energy use in existing buildings. Heidelberg is working on expanding the reach of the district heating network which currently serves 47% of the city, and also working to raise the share of carbon neutral heat from 50% currently to 100% before 2050. The municipal utility currently supplies an impressive 75% of the city's electricity from renewable sources.

JOHANNESBURG

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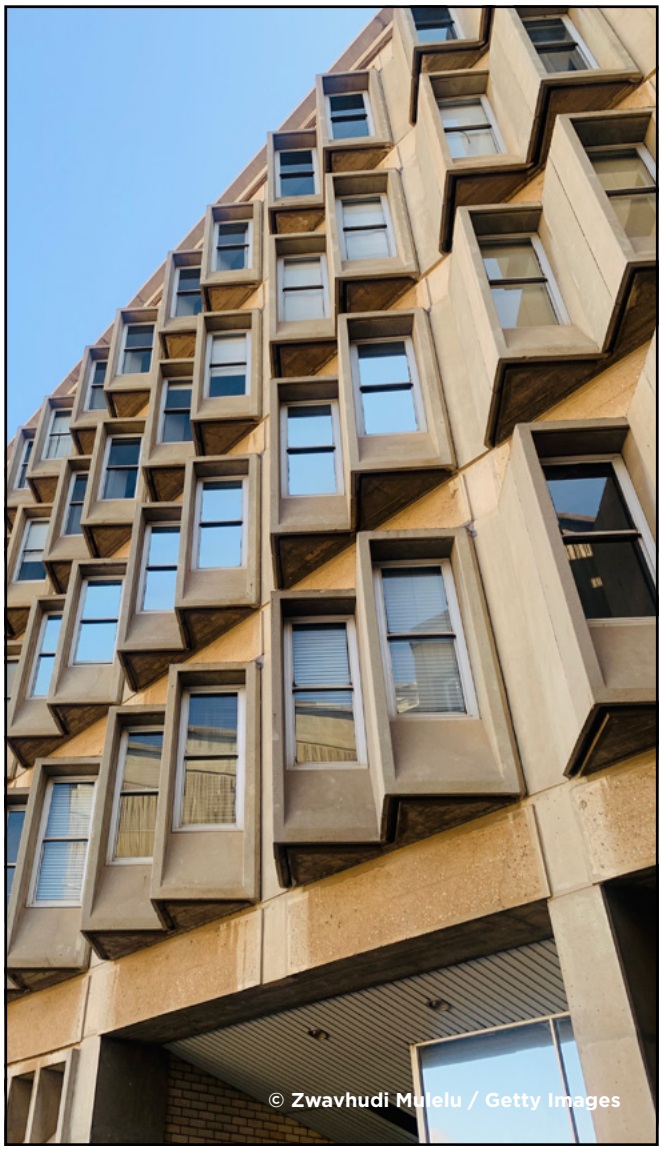
Johannesburg has just completed the policy formulation process of its first Green Building Policy: Transitioning towards a low carbon future. The policy was adopted at the October 2021 council meeting.

The city was able to meet this critical milestone as part of its net zero carbon buildings commitment through the support of the C40 South African Buildings Programme. The programme provided excellent technical support, but also developed a strongly collaborative approach between the participating cities and global partners in the C40 network.

The implementation plan to ensure institutionalisation of the policy will be developed in the coming months. Next steps may also include the drafting of new city building by-laws to ensure that the mandatory requirements can be met as outlined in the policy pathway. This is subject to further engagements with national regulatory bodies.

The city has yet to identify a champion for municipal buildings and develop a programmatic response on deep retrofitting, including a business plan. Energy audits for some municipal buildings are underway, but more funding and internal capacity is required to ensure that this can be scaled up.



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LONDON

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London has been successfully implementing its net zero carbon target for new homes through the London Plan — the mayor's strategic planning document for the city – since 1 October 2016. The new London Plan, adopted in March 2021, extended the net zero carbon target to all major development, including non-residential.

To meet the city's net zero carbon target, developments must achieve a minimum on-site carbon reduction beyond national building regulations by reducing energy demand, being supplied by clean energy, and maximising opportunities for renewable technologies on-site. Once on-site reductions have been maximised, any shortfall to zero is paid into the relevant borough's carbon offset fund, which is ring-fenced for carbon-saving projects such as energy efficiency projects for existing buildings. The city's latest reporting has shown that developments are seeking more ambitious on-site reductions than the minimum target and going far beyond national requirements, reducing reliance on offsets.

The 2020 Energy Monitoring Report (currently in draft format) reports that strategic developments are on average achieving a carbon reduction of 46.2% beyond national standards, which significantly exceeds the mayor's on-site target of 35%. This is a direct result of the London Plan policies.

The London Environment Strategy sets out a range of actions for reducing emissions from existing buildings, from mayoral programmes to actions needed by the government to speed up retrofitting.

As part of the Mayor's £54.4 million Green New Deal (GND), he has declared a 'retrofit revolution' in London, through a package of measures to create low-carbon buildings, tackle the climate emergency and support green jobs. This has involved securing £160 million from government recovery funds to reduce carbon emissions and cut energy bills from homes and public buildings. The Mayor's GND programmes (including Retrofit Accelerator - Homes, Retrofit Accelerator - Workplaces and Warmer Homes) aim to make London's homes warmer, healthier and more affordable; its workplaces more energy efficient; and to supply the capital with more clean local energy.

In addition, the mayor's £500 million Energy Efficiency Fund was launched in July 2018, providing long-term, low-interest loans to public bodies and small- to medium-sized enterprises for energy efficiency and renewable energy projects. The mayor has no direct powers to encourage building retrofits (except for major refurbishments requiring planning consent) but he continues to advocate for the national government to provide the supportive actions necessary to achieve these goals, as well as devolving the powers needed for him to undertake additional actions.

London is delivering on the C40 Equity Pledge commitment by reporting equity and inclusion considerations in its climate actions

London carried out an equity assessment to inform the city's net zero carbon new building roadmap. Key findings show that more energy efficient and cheaper to heat buildings help address the 'food or fuel' issue among lower-income households and the residents most vulnerable to the cold, such as the elderly and children, resulting in an improvement in health inequalities in the city.

LOS ANGELES

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After signing the C40 Net Zero Carbon Buildings Declaration, Los Angeles codified its buildings goals in 2019 through LA's Green New Deal. The city committed to the following policy goals:

- All new buildings will be net zero carbon by 2030.
- All existing buildings will be net zero carbon by 2050. The city will achieve this through interim goals for reduced building energy use intensity: 22% by 2025, 34% by 2035, and 44% by 2050.

In 2020, Mayor Garcetti signed Executive Directive 25 and committed all new municipal construction or major retrofits to achieve carbon neutrality by 2030 and directed major departments to report regularly on plans to achieve carbon-neutral facilities.

In 2021, following the publication of the LA100 study, Mayor Garcetti committed to achieving 100% clean energy at the Los Angeles Department of Water and Power (LADWP) by 2035 to complement the decarbonisation of the built environment.

The LADWP has committed USD 75 million to the new Comprehensive Affordable Multifamily Retrofits programme, supporting energy efficiency and electrification in multifamily buildings serving low-income renters, and it has committed an additional USD 75 million to expand the popular Home Energy Improvement Program that provides free energy efficiency upgrades for eligible customers. It has also launched the Zero by Design programme, which incentivises the design of highly efficient new buildings that go above and beyond industry standards.

The Mayor's Office and LADWP are working together with the LA Better Buildings Challenge to launch a customer resource center and a climate fund for building retrofits. This will expand and improve access to financial incentives to help developers and building owners implement efficiency, decarbonisation, and renewable energy projects.

Los Angeles continues to leverage C40 Cities, the American Cities Climate Challenge networks, and support from technical partners to research and report on building stock characteristics, energy use trends, impacts of decarbonisation on local jobs, and affordable housing. These findings will be of critical importance as the city formally engages stakeholders to create policy mechanisms that will guide the city in decarbonising its buildings, in alignment with its commitments.

Los Angeles is delivering on the C40 Equity Pledge commitment by reporting equity and inclusion considerations in its climate actions

In the delivery of the C40 Net Zero Carbon Buildings Declaration, the city has assessed how shifting all new buildings to net zero carbon by 2030 and all buildings net zero carbon by 2050 can positively impact equity. Residents, particularly those living in multi-family residential buildings, would see indoor air quality improve significantly, while the building's retrofit will create work opportunities in skilled trades.

MEDELLÍN

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Medellin's Sustainable Construction Manual is a technical document integrated into the city's Land Use Plan. It was recently updated by adding sections on recycling demolition and construction waste, and the production of sustainable cement to reduce levels of embodied emissions. Approximately 18,000 new homes are built per year, and for developers that adopt the Sustainable Construction Manual a tax incentive is available under the Municipal Tax Statute. The tax deduction varies from two to 10% subject to the fulfilment of the various criteria related to water, energy savings, passive design, comfort indices, solid waste and others.

There has been an increase in passive design measures, including orientation of building facades, permeable facades for ventilation and natural lighting. Solar photovoltaic systems, LEDs and control systems have also been deployed widely.

The city has established a sustainable construction database to track permitted buildings, floor area and CO_2 equivalent emissions. Retrofits of a number of municipal buildings have led to average energy savings of 22%; with actions including energy audits, envelope upgrades and system replacements, the city also obtained green building certifications.

The energy consumption of City Hall has decreased thanks to the technological modernisation measures that have been implemented, but it remains above average. The city aims to reduce emissions from municipal buildings by 60% and new municipal buildings must meet 100% sustainability and carbon neutral conditions by 2030. The city has also introduced a requirement for auditing and monitoring of municipal buildings. To date only four buildings have been inventoried, out of the total municipal portfolio covering an area of 95,840,786 m^2.

The city plans to reduce emissions by adopting a building energy code that will address embodied emissions alongside energy efficiency. The Social Institute of Housing and Habitat of Medellín aims to improve a minimum of 349 homes by 2023. In order to avoid an increase in the cost of low-income, public and socioeconomic strata 1–3 housing, the municipality will apply its own seals or certifications and will exempt these types of housing from sustainable construction certification seals such as LEED or others.

MELBOURNE

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Melbourne has a proud history of acting on climate change. The city has led the way by reducing greenhouse gas emissions and ensuring its buildings and operations are carbon neutral. Since 2012, Melbourne has been certified as a carbon neutral organisation through the Australian Government's Climate Active Carbon Neutral Program. Melbourne achieved a 76% reduction in emissions between 2011 and 2012 and 2019 to 2020, significantly exceeding the 4.5% per annum science-based target.

Thanks to the Melbourne Renewable Energy Project, the city developed with a group of local governments, cultural institutions, universities and corporations the newly built 39-turbine Crowlands windfarm in regional Victoria. This powers the municipal operations with 100% renewable electricity. In 2020 the council endorsed Priorities for Accelerated Action to respond to the climate and biodiversity emergency, including fast-tracking the switch to gas-free operations for the city's largest existing buildings.

Melbourne is developing improved environmentally sustainable design (ESD) and green infrastructure standards for the municipality and a new emissions reduction plan for the organisation. The Sustainable Building Design Amendment C376 proposal aims to introduce new best-practice ESD Standards to ensure new buildings in the municipality respond to climate change. Once endorsed by the state government, the standards will apply to new buildings in the city of Melbourne as well as alterations and additions over certain size thresholds, and will mean new developments in the city need to achieve specific environmental targets. The new standards will also make buildings cheaper to operate. With the new 2021–2025 Emissions Reduction Plan, Melbourne will continue to show leadership in driving out emissions from our operations, including all of the city's buildings.

In December 2020, Montréal adopted the 2020–2030 Climate Action Plan, which includes specific targets to reach net zero carbon buildings such as eliminating the use of fuel oil in buildings, transforming the entire municipal real estate stock into operational zero carbon stock, and reducing greenhouse gas emissions linked to the use of refrigeration in municipal activities.

In 2020, Ville de Montréal announced a draft by-law banning oil heating systems in all new buildings, including the mandatory removal of heating oil systems in existing buildings by 2030. A phased approach will minimise impacts on the residential sector by targeting non-residential buildings first. In order for these measures to be equitable, they will be adapted for low-income families, with community stakeholders consulted.

To support a net zero carbon road map for existing buildings, Montréal recently introduced a mandatory building greenhouse gas rating and disclosure draft by-law to drive building energy efficiency and to reduce emissions. The draft by-law has been presented to the executive committee for the first reading and should be adopted during 2021.

In 2019, Montréal updated its Building Transformation and Construction Regulations (Règlement sur la construction et la transformation du bâtiment) to require energy star certification for all windows, skylights and patio doors in new residential buildings as well as more stringent energy efficiency measures such as air permeability tests for new buildings.

The Ville de Montréal also supports the development of several affordable, energy-efficient renovation grant programmes.

Depending on the adoption of the greenhouse emission benchmarking draft by-law, building performance standards for existing buildings 2000 m^2 and above will be introduced in the next few years with performance thresholds based on energy benchmarking data. The Ville de Montréal is working to provide free training and building support programmes to help building owners to comply with the greenhouse gas emission benchmarking requirements.

Mayor of Montréal, Valérie Plante

"Climate change is real and the stakes are immense. The latest report from the International Energy Agency is unequivocal. This is a real wake-up call. We need to act quickly, in a number of ways, to reduce greenhouse gas (GHG) emissions. Our regulation on the disclosure and rating of GHG emissions from large buildings is another concrete step towards achieving the reduction of fossil energy consumption. Montréal is following in the footsteps of several international cities that have implemented such measures. I am hopeful that it will serve as a model for all of Québec."
(Quote translated from French).

NEW YORK CITY

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In 2019, New York City passed the Climate Mobilization Act (Local Law 97), one of the most ambitious policies addressing emissions from buildings in any major city. It requires most buildings over 25,000 square feet to meet initial greenhouse gas emissions limits by 2024, and then further limits by 2030. The goal is to reduce the emissions produced by the city's largest buildings by 40% by 2030 and 80% by 2050, while putting the city on a path toward a carbon-neutral future.

The city is also finalising a carbon trading study, which is a feasibility study exploring a carbon credit marketplace to help building owners meet the emissions reductions set forth by Local Law 97. In addition, this law will improve air quality, reducing risk of asthma, emphysema and other health conditions.

By 2030, The Climate Mobilization Act will have reduced six million tons of CO_2 emissions (equivalent to taking over one million cars off the road); created 26,700 jobs; avoided 150 hospitalisations per year; and prevented 50 to 130 deaths per year.

To support new building efficiency, large new buildings must be designed to a whole building energy efficiency standard (Local Law 32 of 2018). Beginning in 2025, new buildings will have to meet tough new requirements while giving developers flexibility in how these targets are met. This will encourage creativity and innovation, helping New York City become a leader in innovative, low-emission building technologies.

The City of New York is leading by example by transforming public buildings. Since 2014, the city has completed 2,700 energy efficiency retrofits and clean energy projects at 1,500 municipal buildings and facilities, including 10.5 MegaWatts of solar PV across 57 facilities. As of April 2020, 73% of the reductions in $PM_{2.5}$ emissions from city buildings occurred in and benefitted vulnerable residents in environmental justice areas, where there has historically been greater exposure to pollution. Cumulative estimated avoided energy costs increased from USD 4.27 million in 2013 to USD 87.21 million in 2020.

NEW YORK CITY

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Additionally, NYC has several programmes designed to accelerate carbon reductions in private buildings. The Carbon Challenge is NYC's public–private-partnership designed to increase collaboration between the private and institutional sectors, and the city. By sharing industry best practices and showcasing achievements, the programme participants are projected to reduce roughly 1.5 million tons of carbon dioxide equivalent citywide and realise nearly USD 800 million in energy cost savings.

The NYC Accelerator is the city's flagship programme to catalyse carbon reduction projects, providing technical assistance, training and education, as well as C-PACE Financing for private buildings. It has helped bring about a reduction of around 95,000 metric tons of CO_2 equivalent.

Former Mayor of New York City, Bill de Blasio

"The City government of New York City, in an average day, uses as much electricity as everybody in the state of Vermont. And by 2025, we will convert all of our electricity that the City government uses to renewable sources. All of it will come from renewable energy. That electricity will come down to us [on two new transmission lines] – zero-emission electricity coming to us [from upstate New York and from Canada]. We're taking actions working with our partners to make sure that our City government doesn't need to get its electricity from fossil fuels."

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All existing buildings in Oslo, whether privately or publicly owned, for residential or commercial use, have historically been operated by electricity, or combined with district heat networks or use individual heating systems based on mineral oil.

Oslo is in a fortunate situation as Norway produces (on average) more renewable energy for use in buildings than it consumes. As there is no hydropower facility within the municipality of Oslo, only indirect emissions associated with hydropower production would be associated with the energy use in the city.

As of 1 January 2020, a national ban came into effect where use of oil/kerosene for heating purposes in apartment/office complexes or private homes are no longer allowed.

Oslo's district heating system is a resource-effective energy system where heat from Oslo's waste management facilities is utilised for heating in buildings, thus reducing electricity consumption. Until 2021, liquid natural gas (LNG) and/or mineral oil was a small ingredient in this system, but is now on the verge of being completely phased out and replaced by sustainable and certified biofuels.

Thus, as of October 2021, Oslo has already delivered on commitments 1 and 3 of the C40 Net Zero Carbon Buildings Declaration. By 2022, Oslo will most likely have delivered on commitment 2, as the negligible amount of LNG in district heating will be completely phased out.

For Oslo, focus and attention is devoted to reducing direct and indirect emissions; energy efficiency measures and systems for new and existing buildings; and stimulating more local renewable energy production. It will do this by setting higher ambitions than national regulations require for energy use in new municipal buildings; fiscally supporting schemes for local energy production for housing cooperatives and commercial buildings; improving policies and approval processes for area plans or single development projects to realise greenhouse gas reductions and energy savings; and investing in pilot programmes (such as FutureBuilt) that aim to reduce emissions from material consumption and the building/renovation process, reduce energy use in buildings, and inspire and drive the market towards climate-friendly urban development.

PARIS

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In December 2020 the city of Paris began a major review of its development guidelines for construction to accelerate the energy transition. Supporting this is the Paris Construction Pact that provides guidelines on energy conservation and low carbon development.

The Éco-renovons Paris project provides technical and financial support enabling the renovation of more than 30,000 condominium homes, bringing the total number of renovated private homes to over 65,000. The city has mobilised € 20.8 million, in addition to € 19.5 million of national funding, to ensure that the programme can be continued. Separate programmes provide financial support for social landlords and 56,105 social housing units out of a total of almost 250,000 have undergone retrofit since 2009 with an average energy efficiency gain of 55%.

For several years, the city has worked to improve the energy performance of schools through Energy Performance Contracts. Energy consumption and greenhouse gas emissions have been reduced by 30% and 300 institutions out of a total of 600 have so far been upgraded.

Schools and colleges are being renovated to offer more natural spaces, more vegetation, better management of rainwater and water points and more fun facilities adapted to the needs of children. Each ‘oasis’ is designed as a neighbourhood asset, available to the whole community, and in particular will become ‘refuges’ for vulnerable people during heat waves.

By 2023, the Saint-Vincent-de-Paul district redevelopment project aims to renovate a former hospital complex based on the principles of ‘zero carbon, zero waste, zero discharge’. The 60,000 m^2 mixed-use site will generate valuable insights into achieving net zero carbon and ‘passive house’ standards in historic buildings.

Porte de Montreuil (2020–2028) will become a low carbon district, strengthening the green belt along the ring road, bringing new economic activity and employment and achieving carbon neutrality. Along with addressing embodied emissions, 7,000 m^2 of additional biodiversity of planted surfaces will be included. This project was a winning entry in C40’s reinventing cities competition.

PARIS

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The Paris Council has approved the objective of renovating 5,000 social housing units, 300 schools and ten swimming pools, with support offered for 15,000 private housing renovations per year.

The city has drawn up an expanded programme to fight energy poverty around four main objectives:

- Improve the systems giving access to information and support for people and households in energy poverty situations making them more readable and efficient,
- Direct resources from the energy renovation policy for Parisian housing towards people in a situation of energy poverty, such as tenants in the private sector and in social housing, very modest owner-occupants, and isolated people,
- Strengthen the training and tools of professionals in the knowledge of energy poverty situations and the avenues of responses to be provided, and
- Coordinate the network of public, associative and private actors against energy poverty, while respecting their respective missions.

The city has launched the Climate Academy, which will be a real place for the exchange of knowledge in connection with the Parisian ecosystem of actors in the ecological transition, and an incubator to accelerate actions carried out by young people. Starting in 2022, the Climate Academy will deliver training and practical and theoretical skill certification to support the professional integration of young people around the challenges of ecological transition. The academy will rely on professional practitioners and their knowledge. It will become a place of resources and training for Parisians, but also for all urban officials who wish for professional development or retraining.

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PORTLAND

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As a signatory to the C40 Net Zero Carbon Buildings Declaration, the city of Portland Bureau of Planning and Sustainability created a net zero carbon roadmap as part of the Zero Cities Project. The Zero Cities Roadmap was a three-year project funded by the Urban Sustainability Directors Network from 2018 to 2020 to develop strategies to achieve a zero carbon building sector. The project centres on racial equity through community collaboration and technical analysis of potential carbon reduction policies. To reach its 2050 goal, the city is continuing to work with community partners to develop climate standards for existing buildings.

To support the efforts in achieving net zero carbon buildings, Portland is working with the Zero Energy Ready Oregon Coalition to advance the Oregon building energy codes for new construction. After stalling for nearly a decade, the state's building energy code is now aligned with the ASHRAE 90.1-2019 national standard. City staff also worked with building owners to verify Portland's first residential net zero energy homes and first commercial net zero energy building.

SAN FRANCISCO

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The city's partnership with SFPUC's (San Francisco Public Utilities Commission) CleanPowerSF program is critical to achieving 100% renewable electricity. To facilitate straightforward compliance, all customers can subscribe to 100% renewable electricity via the grid at a small premium. In 2021, the CleanPowerSF program adopted an integrated resource plan for procurement and delivery of 100% renewable electricity citywide by 2025.

The Department of the Environment, with funding and support from local utility, Pacific Gas and Electric, recently launched the 'EnergyAccessSF' program. The EnergyAccessSF program provides residential and small business customers in San Francisco's disadvantaged communities with access to energy efficiency rebates, technical assistance, and marketing and outreach. EnergyAccessSF uses sophisticated customer targeting techniques, public permit data, and machine learning to identify buildings with a higher propensity to save energy and/or prime candidates for equipment replacement and upgrades. EnergyAccess SF engages the communities with culturally relevant outreach and messaging campaigns to promote cost-saving energy efficiency behavior and rebate programs.

In 2019, the city passed an ordinance, sponsored by Mayor London Breed, that requires all large commercial buildings to switch to 100% renewable electricity. The implementation will start with the largest of commercial buildings (>500,000 sq ft) in 2022 and, over time, apply to almost all commercial buildings (>50k sq ft by 2030).

SAN FRANCISCO

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In 2020, San Francisco adopted two ordinances to bring in mandatory electrification for new construction. The city first banned natural gas in all municipal renovation and new construction projects (city-owned buildings) and later in the year, it banned natural gas in all newly constructed private buildings.

In 2021, San Francisco updated its climate action goals through legislation (Chapter 9 of the Environment Code) to reach net-zero emissions citywide by 2040, and zero emissions from large commercial buildings in the city by 2035.

In late 2021, Mayor London Breed and the San Francisco Department of the Environment released the City's 2021 Climate Action Plan. The data-driven, community-informed, and people-focused plan contains implementable strategies to achieve net-zero emissions by 2040 while building a more just and equitable future. This plan lays out a detailed path of building sector actions consistent with updated climate goals, including incentives, financing, workforce education, and adopting anti-displacement legislation to protect those most vulnerable, and developing policies that will require electrification for a property, either at time of sale or at the time of replacement of fossil fuel equipment.

Maceo May

Maceo May is a modular, all-electric, and affordable residential development being constructed in San Francisco. Climate-responsive design contributes economic value for Maceo May's owners and delivers a stable, healthy living environment for its residents, who are formerly homeless veterans and their families. Developed by two non-profits, Chinatown Community Development Center and Swords to Plowshares, Maceo May will be the second all-electric affordable building in San Francisco. The USD 55 million development will be six stories tall with 105 units when construction is completed in 2022. The development is designed to be protected from sea level rise and to continue operations and remain safe and comfortable during periods of extreme heat, power outages, wildfire smoke, and seismic events. Passive design strategies and superior ventilation also limit energy use, create good air quality, and support the thermal comfort of residents, especially during potential power outages. The building's resilient and sustainable features are essential for fulfilling the core purpose of the building — delivering stability, supportive services, and well-being for its residents.

SEATTLE

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Seattle recently adopted a stringent new energy code requiring all commercial and multi-family buildings taller than three storeys to wire for future electrification of appliances; increase on-site solar photovoltaics; reduce envelope heat loss and air leakage; and reduce interior lighting power allowances, among other measures. The code will also restrict fossil fuel space heating and most fossil fuel water heating systems to reduce dependence on gas and oil. Other local jurisdictions are planning on modelling their code after Seattle's, including King County and the city of Bellingham.

For the 2050 commitment for existing buildings, Seattle is developing an electrification strategy for all municipal buildings. From 2008 to 2019, municipal buildings' energy use has been reduced by over 20%, and emissions reduced by over 24%. For residential existing buildings, the city's Clean Heat programme continues to invest in oil furnace to electric heat pump conversions, completing more than 700 conversions since 2018, including low-income households.

Seattle City Council has plans to expand the residential Clean Heat programme, and has earmarked USD 20 million in tax revenue to support low-income households convert from oil and gas to entirely electric solutions.

The city also plans to complete municipal building electrification and renewable natural gas (RNG) studies. The electrification study will inform the timeline, costs and measures needed to electrify all existing municipal buildings, and the RNG feasibility study will explore the potential use of RNG for municipal buildings as a short-term strategy prior to electrification.

Other plans held by the city of Seattle include:

- Supporting building owners to comply with state building performance standards and acquire state incentives,
- Working with the local utility to plan how to decarbonise the district heating system (currently using fossil fuels for steam generation) by 2050,
- Advocating for legislation at the state level to support cities to decarbonise buildings,
- Advancing key Green New Deal recommendations, including a retrofit accelerator programme and the expansion of the Clean Heat programme, and
- Continuing with policy planning for a Seattle building performance standard to be introduced in 2022–2023, which will directly address emissions.

Former Mayor of Seattle, Jenny Durkan

"Seattle's energy code is not only among the strongest in the nation, it prioritizes protecting the health of our most impacted populations and is a critical mechanism to support our City's transition to a clean energy future"

SEATTLE

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Seattle is delivering on the C40 Equity Pledge commitment by reporting equity and inclusion considerations in its climate actions

In the delivery of the C40 Net Zero Carbon Buildings Declaration, Seattle is applying its race and social justice toolkit to the clean Heat/oil tax policy and the Building Performance Standards policy to assess who benefits and who is burdened by the policies, and to help identify ways to mitigate unintended harm. The toolkit has found that the policies reduce the energy burden for BIPOC and low-income households and improve thermal comfort and indoor air quality among other impacts.

The city of Seattle has proposed specific approaches to address potential negative impacts of NZCB policies. For example, an increase in the cost of oil for seniors and low-income households due to the heating oil tax being passed down from oil dealers to homeowners could be mitigated by providing a tax reimbursement to income-eligible households, while the risk of displacement due to gentrification brought about by building performance standards driving up rents can be addressed through additional incentives and financing mechanisms.

STOCKHOLM

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Stockholm is one of Europe's fastest growing metropolitan areas, and studies have shown that embodied emissions (the emissions associated with the manufacture and installation of building materials) are of the same magnitude as operational emissions (the emissions from using a building) over a 50 year perspective. The city of Stockholm, with partners, have developed a tool to calculate these embodied emissions. The city's residential housing companies are now collecting data on embodied emissions and a target threshold for new buildings is expected to be developed by 2023.

Stockholm has shown success in exceeding national standards for energy efficiency in new buildings, with buildings built according to the city's energy requirements having about 25% lower heat leakage. Verified energy data from new buildings built on land owned by the city is submitted to a central database for benchmarking.

The city offers energy advice to both private building owners and the operators of municipal buildings. Further still, all city-owned buildings report on their progress towards the city's energy efficiency goals.

There are two technologies in use for heating new buildings in Stockholm — ground source heat pumps and district heating, which cover approximately 80% of the demand in Stockholm. The last remaining coal-fired plant in the district heating system was shut down in 2020. Approximately 1,000 residential buildings still have oil boilers, but these are being constantly replaced by geothermal heat pumps or district heating. The city has set a target to phase out all oil burners in Stockholm by 2025.

Stockholm's energy company, Stockholm Exergi — which is 50%-owned by the City of Stockholm — recently piloted Bio Energy Carbon Capture and Storage (BECCS) with plans for a full-scale BECCS plant for storage of carbon under the North Sea. With BECCS in operation, the production of district heating and electricity will have negative CO_2 emissions exceeding the emissions from fossil plastics in waste incineration. The BECCS plant is planned to be in operation in late 2025 if necessary business models and public incentives are implemented. In this context, the European Commission announced on 16 November 2021 that Stockholm Exergi's BECCS-plant has been pre-selected for a grant under the European Innovation Fund. The Nordic electric mix (Scope 2 in international greenhouse gas-protocol) is expected to be fossil free around 2030.

SYDNEY

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The city of Sydney has been a carbon neutral organisation since 2007 with independent certification since 2011. This involves measuring and reducing the city's operational emissions and purchasing carbon offsets for emissions that cannot be avoided.

In July 2020, the city entered into a ten-year renewable electricity power purchase agreement for its operations. Through energy efficiency programmes for buildings and street lighting, electric vehicles and renewable energy, Sydney's operational emissions have been reduced by an estimated 76% below the city's 2006 baseline, which occurred while significantly expanding the city's services and new assets including two new aquatic centres, many parks and three new libraries. Sydney is now looking to purchase renewable gas as a way to decarbonise on a pathway to electrification.

Sydney's Environmental Strategy 2021–2025 commits the city to remain a certified carbon neutral organisation under the Australian Government Climate Active programme with an increasing share of higher quality, nature based carbon offsets. In 2020, the city purchased offsets from Indigenous-led cultural burn, fire stick farming projects in northern Australia.

In July 2021, Sydney brought forward its net zero target for the local government area to be net zero by 2035 in line with the city's fair share of what is required at the global scale to reduce the worst impacts of climate change.

The city has also developed new performance standards to optimise energy efficiency in new office buildings, hotels and shopping centres, and major redevelopments of existing buildings in the local government area. The regulations will come into effect in January 2023 and achieve net zero energy output by 2026.

Sydney is delivering on the C40 Equity Pledge commitment by reporting equity and inclusion considerations in its climate actions

In the delivery of the C40 Net Zero Carbon Buildings Declaration, the city of Sydney is supporting Indigenous enterprises and communities through the purchase of carbon credits created from traditional cultural burn practices, allowing Indigenous rangers, businesses and communities to care for the country with local employment opportunities and new skills to continue traditional ways.

TOKYO

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The Tokyo Green Building Program, launched in 2002, requires new large buildings, including residences, to improve energy performance and use renewable energy. Evaluation standards for zero energy buildings have been applied since 2020.

In 2018, Tokyo developed the Tokyo Zero Emission Housing Standards, providing guidance on net-zero carbon construction in new homes. The standards stipulate higher heat insulation and energy efficiency performance compared to the national standards. Subsidies to incentivise the construction of new houses according to the standard have been in place and providing economic support since 2019.

For existing buildings, the Tokyo Cap-and-Trade Program has been in place since 2010. Tokyo requires large facilities to reduce their total CO_2 emissions through measures such as emissions trading. Currently, the framework is in the third compliance period (2020–2024) and requires a 27% emission reduction compared to base-year levels in order to strengthen the ongoing implementation of energy efficiency measures and the further expansion of renewable energy.

For small and medium facilities, the Carbon Reduction Reporting Program has introduced a new evaluation mechanism promoting the use of renewable energy.

With a view to improving the heat insulation of existing detached houses and apartment complexes, subsidies for the renovation of doors & windows to improve thermal performance and incentives for the replacement of household appliances with more energy-efficient models have been provided as economic support measures since 2017.

In March 2021, Tokyo updated its Zero Emission Strategy formulated in December 2019 and set a new target of reducing greenhouse gas (GHG) emissions by 50% by 2030, under the “Carbon Half” initiative.

In order to clarify further measures for the decarbonization of energy and resources, which is expected to contribute to the reduction of GHGs in areas outside the city and overseas, the Tokyo Metropolitan Environmental Council (an advisory body to the governor of Tokyo) has been developing the Tokyo Environment Basic Plan and is planning efforts to halve GHG emissions by 2030, scheduled for completion in the summer of 2022.

TORONTO

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To ensure new buildings operate at net zero carbon by 2030 (Commitment 1), Toronto's City Council recently adopted the latest revisions to the Toronto Green Standard (v4) that will come into force in 2022. The Toronto Green Standard imposes a tiered approach to absolute performance targets related to greenhouse gas emission limits, energy use intensity and thermal energy demand intensity. The most stringent tier will require new buildings built in 2030 or later to be near zero emission buildings. It will also require upfront assessments of embodied carbon.

To ensure all existing buildings operate at net zero carbon by 2050 (Commitment 2), the City Council recently adopted the Net Zero Existing Buildings Strategy ("ExB Strategy") that provides voluntary emission performance targets for existing buildings that will become mandatory over time. These targets will drive electrification of space heating and cooling, as well as water heating, thereby reducing greenhouse gas emissions from the combustion of natural gas in existing buildings in Toronto.

Toronto is also advocating for utility rate structures that favour electrification and fuel switching, as well as strengthening the capacity of the grid to accommodate widespread fuel switching in buildings.

Regarding municipal buildings in particular, Toronto is pursuing a Net Zero Carbon Plan made up of seven initiatives: fuel switching and efficiency retrofits; lower-carbon new builds; strategic divestment; on-site renewables and storage; training and education; enhanced use of building performance data; carbon offsets, and off-site renewables. The plan provides a road map to achieve net zero emissions in city buildings by 2050 or sooner.

The city will be focusing on unlocking the billions of dollars necessary to fund and finance the scale of retrofits required to make existing buildings net zero emissions buildings. It is expected that all levels of government in Canada (federal, provincial and municipal) as well as private sector actors will have a role to play.

TORONTO

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Toronto is delivering on the C40 Equity Pledge commitment by reporting equity and inclusion considerations in its climate actions

In the delivery of the C40 Net Zero Carbon Buildings Declaration and through its ExB Strategy, the city undertook an equity analysis of the plan for existing buildings within Toronto's community to be net zero by 2050. The main challenges identified relate to exacerbating housing affordability in both the residential sector (costs being passed down to tenants) and commercial buildings sector (where local business owners may face increased costs for building upgrades that will impact their bottom line). These affordability challenges are often felt most by Toronto's equity-deserving groups. The ExB Strategy identifies specific instances where affordability impacts and any other unintended consequences will need special attention, and identifies some high-level mitigation approaches.

As individual policies and programmes recommended in the ExB Strategy undergo detailed design, the city will conduct a further, more thorough, equity analysis to ensure the involvement of the right stakeholder groups and make sure emissions reductions support equity-deserving groups as buildings are transitioned to net zero.

The Toronto Green Standard performance requirements will serve equity-deserving groups by resulting in housing built to the highest standards and qualities with reduced energy, emissions and environmental impacts. The requirements result in new development that is more affordable in the long term due to significantly reduced costs for heating and cooling utility bills, addresses climate change and that provides high quality landscapes and public spaces. High performance buildings are also resilient during extreme weather or power outages allowing homeowners to shelter in place and reducing demand on emergency services.

TSHWANE

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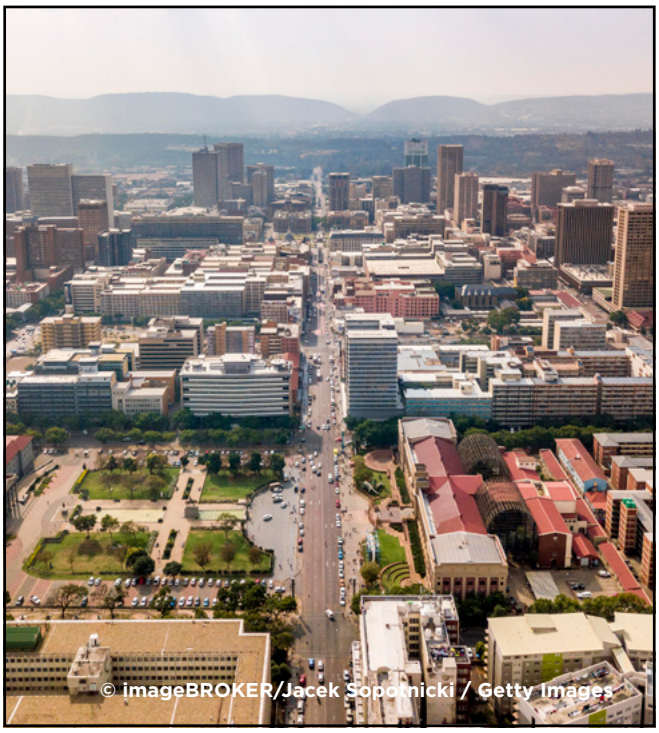
As part of the 2030 net zero carbon new buildings commitment, Tshwane has reviewed and updated its 2012 green building policy and by-law. This has been approved by Council for public participation with Council approval for adoption is targeted later this year. The by-law includes mandatory and voluntary requirements for new buildings and additions and alterations to existing buildings supplementary to the National Building Regulations (NBR). These include net zero carbon building requirements (stringent energy efficiency and renewable energy use), as well as those for water efficiency, waste diversion, non-motorized transport, and adaptation for all new buildings (including new municipal buildings). An implementation plan is currently under development to operationalise the by-law once it is approved, including virtual communications and a media and marketing strategy to raise awareness and support enhanced compliance.

The city's next steps include a further investigation to develop a city-wide incentive scheme to attract investment and enhance compliance with the updated green building by-law for new buildings, roll-out the communications strategy (which has already started in September 2021), undertake industry and Building Control Office capacity building to institutionalize the by-law, and pilot the updated by-law. References to the by-law will be included in the City's spatial development and land use management frameworks and by-laws, facilitating alignment throughout the City and ensuring awareness of and compliance with requirements among developers at the earliest stages of approval.

The by-law is included in the city's soon-to-be launched Climate Action Plan, as well as other actions aligned with the city's existing and municipal building commitments. The city plans to develop a Building Efficiency Retrofit Guideline and Policy for existing buildings aligned with the net zero carbon existing buildings by 2050 commitment. The building policy is also for the city's own buildings implementation of Energy Performance Certificates (EPCs) being piloted, following introduction of recent national legislation in December 2020. Plans are also in place to implement energy audits of municipal buildings through the EPC process that will help inform the city's strategy for improving performance in the city's own buildings towards net zero carbon.



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VANCOUVER

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Vancouver's Climate Emergency Action Plan focuses on reducing the burning of natural gas in buildings, reducing emissions from heating and hot water, and building with lower carbon materials and practices. Over three quarters of emissions from Vancouver's buildings can be cut by switching from natural gas to electricity or biogas for space heating and water heating.

By 2030, the city of Vancouver will ensure carbon pollution from buildings is half what it was in the city's 2007 baseline. In many cases, this involves first reducing energy use by improving insulation, installing better windows, or improving air-tightness. This also includes switching from a natural gas system to an electric heat pump. Heat pumps are many times more efficient than traditional fossil fuel systems and can provide both heating and cooling during the city's increasingly hot summers.

Vancouver's Zero Emission Building plan is a flexible, phased approach to combat and reduce carbon pollution in new buildings. It sets limits on emissions and energy use in new buildings, and the limits will reduce over time supporting a transition to zero emissions buildings in all new construction by 2030. As of January 1, 2022, the Vancouver Building By-law will require zero emissions equipment for space and hot water heating, as well as additional roof insulation, in new low-rise residential buildings.

Additionally, by 2030, the city will reduce embodied emissions from new buildings and construction projects by 40% compared to 2018. Vancouver's Embodied Carbon Strategy sets a vision for a healthy, equitable, circular, and carbon-positive construction economy. The city aims to take responsibility for emissions from extracting, manufacturing, assembling, replacing, and disposing of building materials, such as concrete, metals, and insulation, and is working to change current building practices. This means using materials more efficiently, reusing existing buildings and materials, building more from sustainably sourced timber, using lower-carbon blends of concrete, using low-carbon insulation, and powering construction sites with renewable energy instead of diesel fuel. To deliver on this, the city will set limits on embodied carbon for new buildings while making it easier and less expensive to adopt measures that tackle embodied carbon.

Through this shift, Vancouver will create a thriving local renovation economy, with attractive employment opportunities for technicians, plumbers, insulators, and other skilled trades. This will support an improvement in indoor air quality, and allow building spaces to have cooler conditions in the summer and be more comfortable in the winter through the year-round operation of heat pumps.

WASHINGTON, D.C.

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The 2017 DC Energy Conservation Code has been in effect since 2020 and is expected to save 23.2% in site energy and 15.3% in carbon emissions, compared to the previous code. The code offers a voluntary pathway to achieving net zero energy through passive-design enhanced envelope performance, high-efficiency systems, and using renewable energy to meet remaining energy demand.

The Building Energy Performance Standards (BEPS) were established in 2021 and apply to private buildings 50,000 sq. ft and larger and DC-owned buildings 10,000 sq. ft. and larger. Standards will be re-established every six years and will include smaller buildings in future cycles. Buildings that do not meet BEPS will be placed on a five-year Compliance Cycle and will have to complete a Compliance Pathway aimed at increasing the efficiency of their buildings. Pathways available to building owners include reducing energy consumption by 20%, completing a list of DOEE-approved prescriptive measures, or achieving the BEPS by the end of the Compliance Cycle. By 2050, BEPS is estimated to save nearly one million tonnes of CO_2 equivalent annually.

The city also launched the Building Innovation Hub to help building industry professionals comply with the District's building decarbonization policies including BEPS and to serve as a trusted translator between industry professionals and district entities including the District of Columbia Sustainable Energy Utility, the DC Green Bank, and the District Department of Consumer and Regulatory Affairs. The hub has launched as a digital platform with a growing number of virtual events and training sessions.

DC has a goal to adopt net-zero energy codes by 2026, and the interim code development cycle for 2023 is underway. Other key plans include the DC benchmarking law, which will expand to cover smaller private buildings. Buildings 25,000 – 49,999 sq. ft will begin reporting their annual energy benchmarking data in 2022, and this will expand to buildings 10,000 sq. ft and larger in 2025. Another new measure starting in 2024 will require building owners to have their benchmarking data third-party verified on a three-year cycle.

Finally, DC has launched the Affordable Housing Retrofit Accelerator to deliver customized support to affordable housing building owners seeking to comply with BEPS. The project will braid various funding sources and support from DC agencies to package a comprehensive suite of technical and financial assistance based on affordable housing stakeholder input.

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